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## **ORIENTING AND STACKING PARTS**

### **BACKGROUND OF THE INVENTION**

#### **1. TECHNICAL FIELD**

The present invention relates generally to the orienting and storing of parts, and more particularly to a method and apparatus for orienting and/or stacking parts.

#### **2. BACKGROUND ART**

The manufacturing process for many small parts includes creating the parts on a web that holds many identical parts. This allows for a streamlined process in manufacturing and handling the parts in the early stages of manufacturing, thereby reducing the overall cost of manufacturing. In the early stages, parts can be made of a flexible material. This allows for the web to be made in a roll format, easing storage and handling of the web. After the parts are manufactured, each part must be detached from the web.

One method of detaching parts involves the use of a punch and die combination. The web of parts is aligned between the punch and die so that a single, complete part can be detached. The web material is held under tension to allow for a precise detachment of the part. The punch is then moved to strike the part and separate it from the web. Air flow may be used to assist the punch and die in separating the part from the web. If the

web was previously rolled, parts made of flexible material may revert to a curled shape after being detached.

After detaching the part from the web, the part must be moved away from the punch and die combination to allow the detaching process to continue for other parts.

5 Commonly, a detached part passes through an opening in the die. The air flow described above may further assist in moving the part through the die.

Various methods are used to further remove the newly detached parts. One method allows a detached part to fall onto a conveyor belt that carries the part away. Another method uses a chute to carry the part away from the die. Using either method, an individual often removes each part to prepare it for the next phase of manufacturing. For example, an individual may place each part in a container for shipping or storage.

Alternatively, the detached parts may be collected automatically in a container. One method provides a container placed beneath the die to collect parts after they are detached. However, when the parts are lightweight and flexible, they are subject to random changes in orientation as they fall. Additionally, depending on how a part contacts the container or previous parts, the part may not fall in a proper direction or may not come to rest in a stable position. Consequently, the parts frequently fall into the container in a disordered manner.

20 The disordered assortment of parts in the container creates a need for further handling of the parts in the container before they can be safely shipped or stored in the

container. Additionally, the random assortment causes the parts to encompass extra space, necessitating more frequent halts to the detaching process.

As a result, there exists a need to control the orientation of a part after it has been detached from a web of parts. Additionally, there exists a need to automatically stack a plurality of parts so that they do not require further processing before shipping and/or storage.

## SUMMARY OF THE INVENTION

The invention provides a method and apparatus for orienting a part. The invention further provides a method and apparatus for stacking a plurality of parts.

A first aspect of the invention provides an apparatus for orienting a part, the part having been detached from a web having a plurality of parts, the apparatus comprising: a duct including an interior sloped side, the interior sloped side creating a first opening for receiving the part and a second opening; wherein the part exits the second opening in a substantially vertical orientation.

A second aspect of the invention provides a method of orienting a part, the part having been detached from a web having a plurality of parts, the method comprising the steps of: passing the part through a duct, the duct having an interior sloped side; and orienting the part to a substantially vertical orientation using the interior sloped side.

A third aspect of the invention provides an apparatus for stacking a plurality of flexible circuits, the apparatus comprising: a container for stacking the flexible circuits,

the container including an open end and a contoured end; wherein a relationship between a center of mass of a flexible circuit and a contact point of the flexible circuit with the contoured end creates a moment causing the flexible circuits to stack upon the contoured end.

5       The exemplary aspects of the present invention are designed to solve the problems herein described and other problems not discussed, which are discoverable by a skilled artisan.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

These and other features and advantages of this invention will be more readily understood from the following detailed description of the various aspects of the invention taken in conjunction with the accompanying drawings in which:

Fig. 1 is a two-dimensional cross-section of an apparatus according to one embodiment of the invention;

15     Fig. 2 is a three-dimensional cross-section of an apparatus according to one embodiment of the invention;

Fig. 3 is a two-dimensional cross-section of a u-shaped channel according to one embodiment of the invention; and

Fig. 4 is a two-dimensional cross-section of an apparatus according to one embodiment of the invention.

It is noted that the drawings of the invention are not to scale. The drawings are intended to depict only typical embodiments of the invention, and therefore should not be considered as limiting the scope of the invention. In the drawings, like numbering represents like elements between the drawings.

## **DETAILED DESCRIPTION OF THE INVENTION**

The invention provides a method and apparatus for orienting a part. The invention also provides a method and apparatus for stacking parts.

Referring now to figure 1, a two-dimensional cross-section of an apparatus 10 is shown attached to a die 12. Die 12 is part of a machine that includes a punch 11. A machine including punch 11 and die 12 is commonly known in the art and operates to detach a part 20 from a web 21 having a plurality of parts. Die 12 can include an opening 13 to allow detached part 20 to pass therethrough. Punch 11 and die 12 are only exemplary of the methods for detaching parts from web 21, and the invention applies equally when other methods and machines now known or later developed are used. Other methods of detaching parts include, for example, laser cutting, water jet, etc.

Apparatus 10 is shown including a duct 14. Duct 14 can be permanently or temporarily attached to die 12 by any method now known or later developed. For example, duct 14 may be attached to die 12 by: using a u-shaped channel, molding as part of die 12, slip fitting to die 12 with a spring plunger to retain duct 14, fastening with screws, clamping, etc. Additionally, while duct 14 is shown attached to die 12, it may be

attached to another part of a machine for detaching part 20 from web 21. Alternatively, duct 14 may be placed in the appropriate location without being attached to the machine. While duct 14 is shown as being narrower than die 12, it should be noted that duct 14 can be any of numerous sizes, including, for example, larger than die 12.

5 Duct 14 includes a first opening 22, an interior sloped side 24 and a second opening 26. First opening 22 is disposed to receive part 20 after the part is detached from web 21. Interior sloped side 24 creates first opening 22 and second opening 26.

10 As shown in figure 1, second opening 26 of duct 14 may be smaller than first opening 22. However, second opening 26 may also be substantially the same size or larger than first opening 22. Additionally, duct 14 is shown with a single interior sloped side 24, however, a plurality of interior sloped sides may form first opening 22 and second opening 26. For example, figure 4 is a two-dimensional cross-section of an apparatus 40 including duct 42. In this embodiment, duct 42 includes multiple interior sloped sides 44, 46 that form a first opening 48 and a second opening 50 that is 15 substantially the same size as first opening 48.

20 Figure 1 also shows part 20 at various positions as it passes through the apparatus according to one embodiment of the invention. After being detached from web 21, part 20a is in a substantially horizontal position as it passes through, for example, opening 13 of die 12. Upon passing through first opening 22 of duct 14, one side of part 20b is partially obstructed by interior sloped side 24 causing part 20b to begin to orient

vertically. Part 20c continues through duct 14 and along interior sloped side 24 and eventually is substantially vertically oriented as it exits through second opening 26.

Interior sloped side 24 of duct 14 can be made out of any material that allows part 20 to pass easily. For example, interior sloped side 24 may be made of polymeric material, such as polyethylene, polytetrafluoroethylene, nylon and plastic; or polished metal, etc. Interior sloped side 24 may be planar or any other shape appropriate for a particular part 20. The disposition of interior sloped side 24 may be selected based on a desired orientation of part 20. For example, one end of part 20 may weigh more than the other, therefore, interior sloped side 24 may be disposed to orient the heavier end of part 20 forward. Other methods may assist part 20 in passing through duct 14. Methods include, for example, air flow from the top of part 20, a vacuum source from the bottom, vibration, fluid, etc.

Turning to figure 2, a three-dimensional cross-section of an apparatus 30 is shown attached to die 12. As discussed above, a machine including a die 12 is only exemplary of machines for detaching parts from a web. The invention applies equally to other methods and machines for detaching parts from a web now known or later developed.

Apparatus 30 is shown including duct 14 and a container 16. Container 16 may be attached to duct 14 to hold part 20. Container 16 can be temporarily attached to duct 14 by any method now known or later developed. For example, container 16 may be attached to duct 14 using a u-shaped channel. Figure 3 provides a two-dimensional cross-section of one example of a u-shaped channel. Container 16 can slide onto duct 14 until

it is properly in place to accept a part. A flange can be used to properly hold container 16 in the desired position.

The u-shaped channel provides one method of quickly and easily attaching container 16 to duct 14. Other methods can be used and are covered by the invention. These include, for example, slip fitting container 16 to duct 14 with a spring plunger, clamping, fastening with screws, etc. Additionally, while container 16 is shown attached to duct 14, it may be attached to another part of a machine for detaching part 20 from a web. Alternatively, container 16 may be placed in the appropriate location without being attached to the machine or duct 14.

As shown in figure 2, part 20 may take on a curled shape after being detached from the web. Container 16 is placed so that part 20 enters container 16 after passing through and being oriented by duct 14. Duct 14 operates in substantially the same manner as discussed in relation to figure 1 above. Container 16 includes an open end 32 and a contoured end 34. Contoured end 34 of container 16 substantially conforms to the curled shape of part 20.

While container 16 is shown attached to duct 14, it should be noted that either container 16 or duct 14 can be used without the other. The invention is not limited to the use of container 16 and duct 14 together. For example, duct 14 can be used to orient part 20, which is subsequently carried away by a conveyor belt. Alternatively, container 16 can be used to stack parts not oriented using duct 14.

A B C D E F G H I J K L M N O P Q R S T

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In figure 2, part 20 is shown in several positions as it passes through apparatus 30. Die 12 and duct 14 operate substantially the same as stated above to orient part 20c in a substantially vertical orientation as it exits through second opening 26. Part 20d then passes through open end 32 and continues through container 16 until it contacts contoured end 34. Because contoured end 34 of container 16 substantially conforms to the curled shape of part 20e, part 20e falls forward and settles in container 16 such that the curled shape of part 20e substantially conforms to contoured end 34.

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A second part, having a curled shape that substantially conforms to the curled shape of part 20, can pass into apparatus 30 after part 20. The second part is also oriented by duct 14 and passes through container 16, as discussed above. However, rather than encountering contoured end 34, the second part encounters part 20. Part 20 has settled on contoured end 34 and maintains the curled shape. Therefore, the second part contacts the curled shape of part 20 and settles similarly on part 20. This process can be repeated to stack a plurality of parts.

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In the discussion above, part 20 may be any part that is detached from a web. For example, part 20 may be a flexible part or flexible circuit. The shape of contoured end 34 is such that, when a flexible circuit contacts it, the relationship between the center of mass of the flexible circuit and the contact point with the contoured end creates a moment causing the flexible circuit to stack upon the contoured end. Due to the nature of the flexible circuit, it settles and acquires substantially the same shape as contoured end 34. Therefore, each subsequent flexible circuit contacts a previous flexible circuit with

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substantially the same shape as contoured end 34 and stacks similarly. The flexible circuit may include plastic with metal circuitry. An adhesive may be present on one side and may be covered by an adhesive liner. It is understood, however, that the invention applies equally to parts that are not flexible or curled.

5           The foregoing description of various embodiments of this invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and obviously, many modifications and variations are possible. Such modifications and variations that may be apparent to a person skilled in the art are intended to be included within the scope of this invention as defined by the accompanying claims.

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